

CLAIMS

I/We claim:

- [c1] 1. An apparatus for retrieving an unmanned aircraft in flight, comprising:
- a support structure;
 - a flexible recovery line carried by the support structure, the flexible recovery line being suspendable from the support structure and having an intercept portion positioned to intercept an unmanned aircraft in flight;
 - a hoist device coupled to the recovery line to retract the recovery line; and
 - a trigger device operatively coupled between the recovery line and the hoist device to change from a first configuration to a second configuration when a tension is applied to the recovery line at the intercept portion, the trigger device being positioned to actuate the hoist device to retract the recovery line when the trigger device is in the second configuration.
- [c2] 2. The apparatus of claim 1 wherein the support structure includes a first portion and a second portion, and wherein at least one of the first and second portions is movable relative to the other.
- [c3] 3. The apparatus of claim 1 wherein the hoist device includes at least one of a spring, weight, hydraulic actuator, pneumatic actuator, and electric motor.
- [c4] 4. The apparatus of claim 1, further comprising a restraining device operatively coupled to the support structure, wherein the restraining device is positioned to releasably engage at least a portion of the aircraft upon retraction of the recovery line.

[c5] 5. The apparatus of claim 1, further comprising a damper operatively coupled to the recovery line to smooth out the action of the hoist device.

[c6] 6. The apparatus of claim 1, further comprising the aircraft, and wherein the aircraft includes a lifting surface and a capture device mounted to the lifting surface and configured to releasably secure the aircraft to the recovery line when the aircraft intercepts the recovery line.

[c7] 7. The apparatus of claim 1, further comprising a rotatable base, wherein the support structure is pivotally mounted on the rotatable base.

[c8] 8. The apparatus of claim 1 wherein the support structure is configured to carry both a lateral load and a vertical load via the recovery line.

[c9] 9. An apparatus for retrieving an unmanned aircraft in flight, comprising:

- an extendable boom having a first portion and a second portion, at least one of the first and second portions being movable relative to the other;

- a flexible recovery line suspendable from the extendable boom in a generally downward direction and having an intercept portion positioned to intercept an unmanned aircraft in flight;

- an axially extendable member coupled to the recovery line to retract the recovery line;

- a restraining device carried by the boom and operatively coupled to the recovery line, the restraining device being positioned to releasably engage at least a portion of the aircraft during retraction of the recovery line; and

- a trigger device operatively coupled between the recovery line and the axially extendable member to change from a first configuration to a second configuration when a tension is applied to the recovery line at

the intercept portion, the trigger device being positioned to actuate the axially extendable member to retract the recovery line when the trigger device is in the second configuration.

[c10] 10. The apparatus of claim 9 wherein the axially extendable member includes a spring.

[c11] 11. The apparatus of claim 9, further comprising a damper operatively coupled to the recovery line to smooth out the action of the axially extendable member.

[c12] 12. The apparatus of claim 9, further comprising the aircraft, and wherein the aircraft includes a lifting surface and a capture device mounted to the lifting surface and configured to releasably secure the aircraft to the recovery line when the aircraft intercepts the recovery line.

[c13] 13. The apparatus of claim 9, further comprising a rotatable base, wherein the extendable boom is pivotally mounted on the rotatable base.

[c14] 14. The apparatus of claim 9 wherein the extendable boom is configured to carry both a lateral load and a vertical load via the recovery line.

[c15] 15. An apparatus for retrieving an unmanned aircraft in flight, comprising:

support means;

recovery means carried by the support means, the recovery means being suspendable from the support means and having an intercept portion positioned to intercept an unmanned aircraft in flight;

hoisting means coupled to the recovery means to retract the recovery means after capture of the aircraft in flight; and

trigger means operatively coupled between the recovery means and the hoisting means to retract the recovery means when a tension is applied to the recovery means at the intercept portion.

[c16] 16. The apparatus of claim 15 wherein the support means includes an extendable boom having a first portion and a second portion, with at least one of the first and second portions being movable relative to the other.

[c17] 17. The apparatus of claim 15 wherein the recovery means includes a flexible recovery line suspendable in a generally downward direction from the support means.

[c18] 18. The apparatus of claim 15 wherein the hoisting means includes a spring operatively coupled to the recovery means.

[c19] 19. The apparatus of claim 15, further comprising restraining means carried by the support means and positioned to releasably engage at least a portion of the aircraft upon retraction of the recovery means.

[c20] 20. An apparatus for constraining motion of a captured aircraft, comprising:

a support structure carrying a flexible recovery line having an intercept portion positioned to intercept an unmanned aircraft in flight; and
a restraining device operatively coupled to the support structure, the restraining device positioned to releasably engage a portion of the aircraft captured by the recovery line.

[c21] 21. The apparatus of claim 20 wherein the restraining device includes a pipe operatively connected to the support structure, and wherein the recovery line passes through the pipe.

[c22] 22. The apparatus of claim 20 wherein the restraining device includes a soft resilient member positioned to releasably engage at least a portion of the aircraft.

[c23] 23. The apparatus of claim 20, further comprising a hoisting device coupled to the recovery line to retract the recovery line after the aircraft intercepts the line.

[c24] 24. The apparatus of claim 20, further comprising the aircraft, the aircraft having a lifting surface, and wherein the restraining device is positioned to releasably engage the lifting surface.

[c25] 25. A method for retrieving an unmanned aircraft in flight, comprising:
 deploying a flexible recovery line from a support structure, the flexible recovery line being suspendable from the support structure and having an intercept portion positioned to intercept an unmanned aircraft in flight;
 flying the aircraft to intercept the intercept portion of the recovery line in flight;
 releasably capturing the aircraft in flight with the recovery line;
 activating a trigger device operatively coupled between the recovery line and a hoist device to retract the recovery line when a tension is applied to the recovery line at the intercept portion; and
 retracting the recovery line with the hoist device.

[c26] 26. The method of claim 25 wherein the aircraft includes a wing, and wherein capturing the aircraft includes releasably securing the wing to the recovery line.

[c27] 27. The method of claim 25, further comprising applying tension to the flexible recovery line after deploying the recovery line and before releasably capturing the aircraft.

[c28] 28. The method of claim 25, further comprising lengthening an extendable tension member coupled to the flexible recovery line when intercepting the aircraft with the flexible recovery line.

[c29] 29. A method for handling an unmanned aircraft, comprising:
deploying a flexible recovery line from an extendable boom, the flexible recovery line being suspendable from the boom and having an intercept portion positioned to intercept an unmanned aircraft in flight;
flying the aircraft to intercept the intercept portion of the recovery line in flight;
releasably capturing the aircraft in flight with the recovery line;
activating a trigger device operatively coupled between the recovery line and an axially resilient member to change the trigger device from a first configuration to a second configuration when a tension is applied to the recovery line at the intercept portion, the trigger device being positioned to actuate the axially resilient member to retract the recovery line when the trigger device is in the second configuration;
retracting the recovery line with the axially resilient member;
releasably engaging at least a portion of the aircraft with a restraining device; and
retrieving the aircraft from the flexible recovery line.

[c30] 30. The method of claim 29 wherein the method further comprises moving at least one of the first and second portions of the boom relative to the other after capturing the aircraft to place the boom in a retracted position before retrieving the aircraft.

- [c31] 31. The method of claim 29 wherein the aircraft includes a wing, and wherein capturing the aircraft includes releasably securing the wing to the recovery line.
- [c32] 32. The method of claim 29, further comprising applying tension to the flexible recovery line after deploying the recovery line and before releasably capturing the aircraft.
- [c33] 33. The method of claim 29, further comprising lengthening the axially resilient member coupled to the recovery line when intercepting the aircraft with the recovery line.
- [c34] 34. A method of constraining motion of a captured aircraft, comprising:
 deploying a flexible recovery line from a support structure, the flexible recovery line having an intercept portion positioned to intercept an unmanned aircraft in flight;
 releasably capturing the aircraft in flight with the flexible recovery line;
 retracting the recovery line; and
 releasably engaging at least a portion of the aircraft with a restraining device operatively coupled to the support structure.
- [c35] 35. The method of claim 34, wherein retracting the recovery line includes activating a trigger device operatively coupled between the recovery line and a hoist device to retract the recovery line when a tension is applied to the recovery line at the intercept portion.
- [c36] 36. The method of claim 34, further comprising applying tension to the flexible recovery line after deploying the recovery line and before releasably capturing the aircraft.

[c37] 37. The apparatus of claim 34 wherein the restraining device includes a soft resilient member, and wherein releasably engaging the aircraft with the restraining device includes contacting and releasably securing at least a portion of the aircraft with the soft resilient member.